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Mathematics As Worship

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"I have never proceeded from any 'Genus supremum' of the actual infinite. Quite the contrary, I have rigorously proved that there is absolutely no 'Genus supremum' of the actual infinite. What surpasses all that is finite and transfinite is no 'Genus'; it is the single, completely individual unity in which everything is included, which includes the *Absolute*, incomprehensible to the human understanding. This is the *Actus Purissimus*, which by many is called *God*."

—Georg Cantor
(quoted from Aczel (2000, p. 188))

I

In keeping with the mission of this organization to explore the relationship of faith to our discipline, I would like to take this opportunity to investigate the relationship, if any, between mathematics and worship. There have been throughout history, at least since Pythagoras, connections made between the mathematical and the theological. Many of these such efforts have followed the Pythagorean cult in deifying number, thus making mathematics the object of worship. Others have effectively situated theology in subservience to mathematical reason. However, these are not the only alternatives.

Once we admit the possibility of a connection between mathematics and theology, which must be an instance of the informing relationship between faith and reason, some important questions arise. First, which informs which: Does our faith constrain the mathematical structures we are willing to posit exist? Or, does our understanding of mathematics illuminate and expand our potential comprehension of the Divine (or even demonstrate God's existence)? Is there a mystical secret nature to numbers that could unlock access to Divine knowledge and power? What is the origin and nature of mathematics? Does it exist in the Mind of God? Is God constrained by the laws of Logic? Is mathematics simply an artifact of the structure of the universe? Is mathematics the product of the pure reason of a disembodied human mind? Is mathematics a socio-historical construction held within the collective consciousness of our culture? Is mathematical knowledge conditioned by the limitations of the physical bodies we inhabit?

While answers to these questions are certainly of interest to us, and I will visit some of them in the course of this investigation, the question of immediate regard here is whether there can be a proper role for mathematics in worship.

I suspect that the very question itself is vulnerable to swift dismissal by Christian mathematicians for one of two reasons. First, it could be suggested that I am advocating some kind of numerological idolatry. On the contrary, although there may exist the potential for mathematics to be a medium of worship, it is my position that there is no aspect of mathematics that is inherently deserving of worship. Second, I'm sure that there will be some readers that will view an affirmative answer to the question as trivial or tautological, and therefore not interesting. If true worship encompasses the whole life of the Christian and not only a few hours a week spent in corporate worship, then the question, and its answer, may appear simple. However, I believe that there are deeper consequences of this perspective that are worthy of examination. For if the nature of mathematics is such that it can be worshipful, then we are not entirely free in the commitments we make in answering the more fundamental philosophical questions.

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II

Of course, worship is a central aspect of all religious activity. Not surprisingly, then, the term worship has taken on a variety of meanings and connotations within the religious communities and cultures of our world. It is necessary, therefore, to clarify what I intend when I ask whether mathematics can or should be a part of worship. For example, I am not suggesting that mathematical proofs, problem solving sessions, or computation should be integrated into the worship services of any sect or church body. I am not recommending that Euclid's *Elements* be considered as an auxiliary to the *Common Book of Prayer*, or the Scriptures. Rather, I would like to take worship in a broader, more inclusive sense as the primary and necessary response of Man to his Creator.

This is, in fact, a perspective that is more consistent with the Biblical notion of worship. The most common Greek word in the New Testament (appearing 60 times) that is translated 'worship' is *proskuneo*, which literally means 'to fall down,' 'to make obeisance to,' 'do reverence to,' and 'prostrate oneself before.' (Vine, *WORSHIP*; Luter, p. 338) William H. Marling has traced the history of *proskuneo* from its Old Testament roots through the context of its usage in the New Testament. The conclusion of his exegetical study is a recommendation that worship not be regarded as (inherently) liturgical or ritualistic, but rather as "a life-style of submission, in obedience to God." (Marling, p. 66) This in no way diminishes the value of liturgy in the experience of the worshipper. It merely establishes the Biblical role it can serve as one possible medium of worship. He quotes David G. Peterson to illustrate this point:

"The congregational meeting will also provide people with opportunities for worshipping God with responses of faith and obedience. Nevertheless, such worship is clearly to be expressed at all times and in all places by the Christian." (Peterson p. 38; quoted in Marling, p. 69)

Another effort to strike a balance between corporate and individual worship (Luter, 1988) focused on another New Testament Greek word, *latreuo*, that is sometimes translated 'worship,' although it is more often rendered 'serve.' In his study, Luter focuses on the use of *latreuo* in four passages: Philippians 3:3, John 4:23-24, Hebrews 13:15-16, and Romans 12:1. Once again, the exegetical evidence suggests that "the form of worship is not primary to our understanding of true worship." (Luter, p. 340) In fact the use of *latreuo* in Romans "implies that the true worship which God desires embraces the whole of the Christian's life from day to day." (Cranfield, p. 601, quoted in Luter, p. 342).

So it is clear that a distinction can be made between corporate, congregational worship and individual, personal worship, and that we are called to both. But how is the latter manifested? In the classic volume entitled *Worship* Evelyn Underhill depicts worship as the living, beating heart of the Christian life. Here is how she describes it:

"...for its object is to lead human souls, by different ways, to that act of pure adoration which is the consummation of worship. ...Though we find at its heart the adoring response of spirit to Spirit, its periphery is great enough to include all the expressive acts and humble submissions of men, if they are given a Godward orientation." (Underhill, pp. vii, 5)

Whether it is possible to view mathematics as one of these Godwardly-oriented expressive acts or not I will address presently. First, however, it is important that we review briefly the historical evolution of thought on the relationship between theology and mathematics over the last two and a half millennia.

III

The Pythagoreans represent the earliest systematic cult of number. Prior to Pythagoras (6th century BC) there is little evidence of numbers and mathematics being anything other than practical tools of civilization. Some speculation has been made, however, that Pythagoras was influenced by ancient Egyptian and Babylonian thinking (or even Buddha) during his famous travels through Mesopotamia, Africa, and Asia (Bell, 1946). Based on historical records, for instance, it is impossible to ascertain the direction of causal influence between Pythagoras and the Hebrew roots of Cabbalistic thinking. Although the Jews were in exile in Babylon during the time of his journeys

through the Middle-East, and subsequent numerological elements began to appear in Hebrew texts during the inter-testamental period (Davis, 1968), there is some dispute over who inspired whom. Was Pythagoras exposed to an early oral tradition of Gematria¹ amongst the Jews, or did the later spread of the Pythagorean cult influence the apocryphal authors? In any case, Pythagoras was the first to build a metaphysics around number: "Number is the ruler of forms and ideas, and is the cause of gods and daemons." (Pythagoras, *The Sacred Discourse*) Or as George Lakoff paraphrases the Pythagorean ontology, "The Essence of Being Is Number." (Lakoff & Johnson, 1999)

The Pythagoreans, who believed that everything is number, worshipped number as deity. Pythagoras defined number as "that which prior to all things subsists in a divine intellect, by which and from which all things are coordinated, and remain connumerated in an indissoluble order." (Taylor, 1816, p. 3) Each number was philosophically adorned with various attributes ranging from physical to supernatural to mythic to aesthetic to moral. For example, according to Nicomachus the Pythagoreans described the tetrad (the number four) as

"...the greatest miracle, a God after another manner (than the triad), a manifold, or rather, every divinity. It is also the fountain of natural effects, and is the key-bearer of nature. It is the introducer and cause of the constitution and permanency of the mathematical disciplines. It is likewise the nature of Aeolus, Hercules, and elevation, most robust, masculine, and virile. It is Mercury and Vulcan, Bacchus and Soritas, Maiadeus or Maiades. For the tetrad is the son of Maia, i.e. of the duad. ...It is also of a feminine form, is effective of virility, and excites Bacchic fury. It is likewise Harmonia or Harmonia, and among the muses, Urania" (Taylor, 1816, pp. 180-1)

As extreme and incompatible with a Christian view of God as this viewpoint may seem, this cult had a profound impact on Greek philosophy, much of which in turn has had a formative role in the development and evolution of Judeo-Christian theology and doctrine ever since. As a case in point, the doctrine of the immutability of God (à la St. Augustine) depended for its formulation upon the Platonic notion of Forms or Ideals and the metaphysical Unity of Being as put forth by Parmenides (Henry, 1976).

The period of history from the formation of the early Church until the 17th century can be characterized, for the purposes of our study, in terms of the efforts on the part of theologians, such as Augustine and Aquinas, to work out a compatible union between Neo-Platonism and Christian doctrine on a metaphysical/philosophical level. For the most part this involved the abandonment of the mystical pseudo-religious beliefs of the Pythagorean cult, while maintaining its essential metaphors and principles. Nevertheless, not everyone cast off the numerological elements. This period also saw the mystical branches of Judaism and Christianity flourish and mature, of which Kabbalah was the most significant. Many students of Kabbalah believe that the origin of their tradition dates back to Solomon, Moses, or even Melchizedek (Low, 1996), thus pre-dating Pythagoras by centuries. On the other hand, some scholars would trace the origins of Kabbalah only back to the Neo-Pythagoreanism of the first century AD (Davis, 1968; Scholem, 1962). Here is a succinct explanation of Kabbalah taken from the Oxford Companion to Philosophy:

"Kabbalah invokes an elaborate cosmology based on the theurgic powers of the Hebrew alphabet, conceived in Neoplatonic and neo-Pythagorean terms as the instrument of creation. The letters, whose numerical values figure in esoteric glosses of Scripture, link creation with the supernal sephirot, archetypal attributes of the Infinite [Divinity], whose Self-confinement (tsimtsum) gives definition to creation and revelation, but also explains human freedom and the possibility of evil." (Scholem, 1995)

So it is evident that from the dawn of Western Civilization and through the Middle Ages the heart of mathematics was strongly tied to religious thought. Eventually, however, the humanism of the Renaissance and the empiricism of the Scientific Revolution began to open the door for the breakdown of this marriage. Scientism, the granting of absolute authority to the empirical and objective, became the mistress of the modern mind. The resulting 'mathematization' of science and culture (Howell & Bradley, 2001) had a myriad of consequences. The Church was

¹ The assignment of mystical meaning to words based on the numerical values of their composite letters.

no longer perceived as having a monopoly on Truth. The success of mathematics in accounting for the structure and behavior of the physical universe ultimately led to a naturalistic version of the Pythagorean ontology that 'Everything is number.' The divorce of theology and mathematics in the modern age created the 20th century crisis of 'Foundationalism' in mathematical philosophy.

The various attempts to address this crisis have fallen into three ontological categories. *Logicism*, proposed by Frege and developed by Russell and Whitehead, took a reductionist approach by attempting to construct all of mathematics from logical propositions. Brouwer instead defended a minimalist ontology, *Intuitionism*, in which only that which can be constructed by the human intellect is admitted as real. Typically this rules out infinity and the excluded middle. An eliminativist system known as *Formalism*, characterized by Hilbert's Program, cast mathematics as a game without content. Only structure and form matter.

The supernatural or metaphysical foundation of mathematics had simply been taken for granted prior to the scientific revolution. At the heart of all of these 20th century philosophies was an attempt to fill the void left by the secularization of mathematics. The failure of the Foundational Program to produce an adequate accounting of the nature and origin of mathematics has, in turn, paved the way for any number of post-modern, humanistic views of mathematics. The Association of Christians in the Mathematical Sciences is beginning to provide alternatives. The recent publication of *Mathematics in a Postmodern Age: A Christian Perspective* (Howell & Bradley, 2001) is a case in point.

IV

What lesson can we learn from this historical survey? That the legacy of Pythagoras is 'Theology in subservience to Mathematics.' Since Augustine, Christian scholars have used mathematical arguments to shore up their theological positions. Augustine assimilated aspects of the Platonic view of divinity, namely the doctrine of the immutability of number and truth, into Christian theology. Other examples include St. Thomas Aquinas' five proofs of the existence of God, Descartes' use of mathematical certainty in demonstrating God's existence, and Pascal's Wager. Perhaps the most striking demonstration of theology's dependence on mathematics was the crisis surrounding the discovery of non-Euclidean geometries in the 19th century. As Reuben Hersh puts it, "Geometry served from the time of Plato as proof that certainty is possible in human knowledge—including religious certainty." (Hersh, 1997)

Granville C. Henry, Jr. very effectively made a similar argument almost three decades ago (Henry, 1976). Henry contends that not only is there a connection between mathematics and Christian theology, but that it is mathematics that has had the formative influence on theology, and not the other way around. The nature of this influence, according to Henry, is epistemological:

"[Mathematics] has essentially affected modes of knowing (what we can know and how we can know it)—not by the *objective content of mathematics* but through *semi-formalized structures associated with mathematics that are only later objectivized and then seen to be a part of the actual content of mathematics*. Thus the philosopher and theologian may not recognize that it is the content of mathematics, which is only later so identified, that affects general perspectives of knowing." (Henry, 1976, p. 46; emphasis original)

He offers classical deductive logic, only formalized (algebraically) recently in mathematical history, as a prime example.

What is essential for Christian mathematicians to realize is that epistemological progress in mathematics is devastating to Christian theology under the Pythagorean legacy. In the same way that the development of new mathematical models has allowed us to change physical paradigms concerning the structure of the universe, the new mathematical structures that have been used to resolve paradoxes in both mathematics and philosophy have altered our notions of truth, knowledge, and the nature of being. Despite the appearance that mathematics, of all the academic disciplines, has resisted longest the influences of post-modernism, perhaps we should question whether or

to what degree it is *actually responsible* for the relativistic intellectual atmosphere that supplanted the empirical certainty of the modern era.

V

So what, then, would it mean to talk of mathematics as worship? An immediate consequence is the reversal of roles: rather than theology being contingent upon mathematics, mathematics is now subservient to faith. As a vehicle or mechanism of worship it is necessarily a lesser thing than God who is the object of worship. While not denying the absolute nature of much of mathematics, it does suggest that mathematics cannot be an independent source of Truth. In other words (and contrary to popular opinion), the certainty of our faith is what guarantees our certainty in mathematics. As I have said elsewhere, all knowledge is contingent upon faith (Stucki, 1999). It is incumbent upon us, therefore, to examine carefully the mathematical assumptions and philosophies we embrace in the light of our prior theological doctrines.

Evelyn Underhill talks of the theocentric character of worship: that it is an acknowledgement of the mystery of the Eternal and has as its source a sense of God (Underhill, 1936, p. 7). In mathematics we contemplate the infinite. Certainly Cantor, himself a student of Kabbalah, saw a spiritual element in his work with transfinite numbers. I have even experienced a greater sense of awe and appreciation for the majesty of God by considering the outrageously large *finite* numbers produced by the Ackermann function. Another body of mathematical work that should inspire a worshipful attitude in the Christian mathematician is the incompleteness theorems of Gödel. These famous results are often viewed pessimistically by mathematicians and philosophers. However, since they indicate that truth transcends knowledge, they validate a biblical perspective.

Worship is also, according to Underhill, always a response to revelation, either natural or special (p. 12). David Neuhouser provides an excellent illustration of mathematics employed in this fashion in his paper 'C. S. Lewis, George MacDonald, and Mathematics:'

"...a passage from MacDonald which shows how much he loved mathematics and how his enjoyment of it led to the praise of God. A character in the novel *The Elect Lady* [asks] a series of rhetorical questions to himself, 'Do I meet God in my geometry? When I so much enjoy my Euclid, is it always God geometrizing to me? Do I feel like talking with God every time I dwell upon any fact of his world of lines and circles and angles? Is it God with me, every time that the joy of life, of a wind or a sky or a lovely phrase, flashes through me?—'Oh my God,' he broke out in speechless prayer as he walked... 'Oh my God, thou art all in all, and I have everything! The world is mine because it is thine! I thank thee my God, that thou hast lifted me up to see whence I came, to know who is my Father, and makes me his heir! I am thine, infinitely more than my own; and thou art mine as thou art Christ's!'" (Neuhouser, 1998)

Finally, if as we have seen, true worship is reflected in the day-to-day activities of the worshipper, then the vocation of mathematics surely is a candidate. Author Iain Pears, in his historical novel, *An Instance of the Fingerpost*, entangles the mathematician and founding member of the Royal Society, John Wallis, in a murder mystery. Here is how he imagines Wallis describing his work in cryptography:

"But how wonderful it is also to penetrate the secrets of men's minds, to turn the chaos of human endeavor into order and bring the darkest deeds from night into daylight. A cipher is only a collection of letters on a page; this I grant. But to take that confusion and turn it into meaning through the exercise of pure reason provides a satisfaction which I have never managed to communicate to others. I can only say that it is not unlike prayer. Not vulgar prayer, in which men chant words while their minds are elsewhere, but true prayer, so complete and profound that you feel the touch of God's grace on your spirit. And I have often thought that my success shows His favor, a sign that what I do is pleasing to Him." —Fictionalized John Wallis (Pears, 1998, p. 404)

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